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Periodically-poled ferroelectric crystals proved to be the most promising technique for exploiting at the best nonlinear optical frequency conversion properties of materials using quasi-phase matching (QPM).

Until now the common method for obtaining periodically-poled ferroelectric crystals is by electric-field poling. In this technique local inversion of the spontaneous polarization is produced in a single-domain crystal by applying an electric field on a periodic electrode deposited on the crystal surface. The poling technology for nonlinear crystals like $KTiOPO_4$, $LiNbO_3$ and $LiTaO_3$ is by now reliable to produce QPM gratings with periods down to about 8 µm. But the thickness of the periodically poled slabs is restricted to 1 mm for these gratings periods, which limits their use to low- and medium- power applications. [1]

To overcome the thickness limitation we have proposed a novel flux growth method for periodically domain-structured $KTiOPO_4$ ("*PPKTP*") crystals with preliminary successful results. Thick layers of PPKTP were grown onto 1-mm-thick PPKTP seeds (Λ = 39 µm), these seeds being obtained by electric field poling prior to the grwth step.

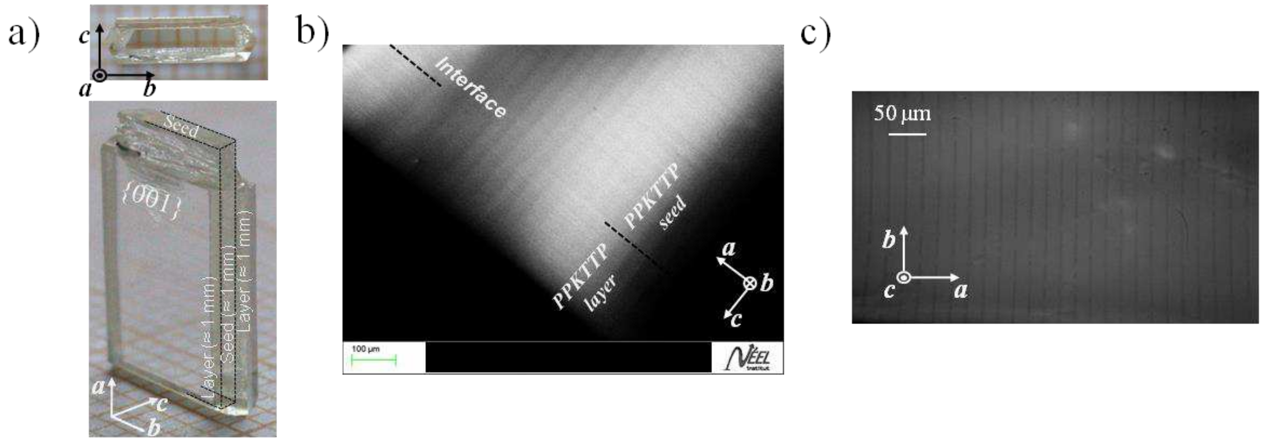

Fig1. Periodically domain-structure-KTP film grown on a PPKTP in a flux with the composition 0.1 KTP – 0.6 KPO_3 – 0.3 KF. **a)** Picture of a PPKTP crystal and the corresponding orientation used for the growth. b) SEM image along the ***b*** axis of the grown layer and seed. c) SEM image along the ***c*** axis of the grown layer at 225 µm far from the surface of one side of the seed.

The crystalline quality and QPM Second Harmonic Generation (SHG) properties of the grown layer were very similar, showing that this technology meets well the requirement for template-growth of engineered PPKTP or other nonlinear structures. [2, 3] In parallel to this work progress was done in obtaining 5 mm thick $PPRb_{1-x}K_xTiOPO_4$ crystals (Λ = 39 µm). [4]

The next step was then to explore the possibility to obtain thicker PPKTP crystals of shorter grating periods using liquid phase epitaxy. For this, we have chosen $PPRb_{1-x}K_xTiOPO_4$ sample with a periodicity of 9 µm as a seed since it is more homogeneous both in terms of domain structure and stoichiometry than conventional PPKTP. The results dealing with these new experiments will be presented.

1. V. Pasiskevicius, *et al.*, *Optical Materials* **34**, 513 (2012).
2. A. Peña, *et al.*, *Optical Materials Express* **1**, 185 (2011).
3. A. Peña, *et al.*, *Journal of Crystal Growth* **360**, 52 (2012).
4. A. Zakauskas, *et al.*, *Optical Materials Express* **1**, 201 (2011).

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